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Research Paper

Diverging perceptions by social groups on cultural ecosystem services provided by urban green

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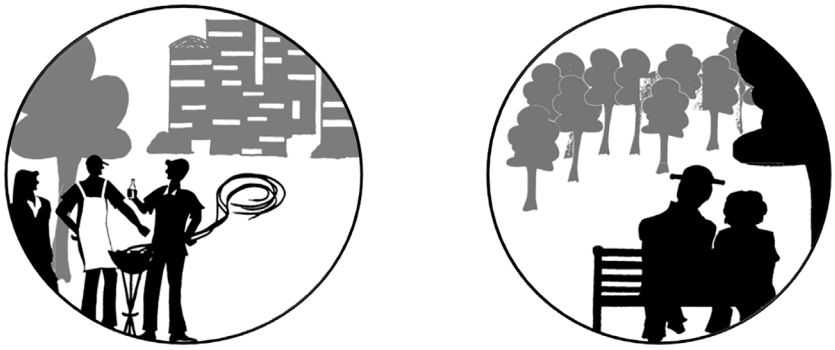
GRAPHICAL ABSTRACT



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ABSTRACT

Global environmental and social changes will have great impact on the development of cities in the coming decades. Impacts of climate change, demographic shifts and conservation of biodiversity should be incorporated into urban green space planning to balance for the increasing development pressure of cities. Urban green spaces provide multiple ecosystem service benefits to diverse social groups. In this paper, we analyzed inhabitant perceptions of cultural ecosystem services provided by urban green spaces in the city of Berlin based on a face-to-face questionnaire (n = 558). As analysis tool, we used proportionate cluster sampling and focused on non-monetary statements on the perceived importance of a broad spectrum of cultural ecosystem services. Results show that cultural ecosystem services can be perceived through bundles and that those bundles may have negative influence on each other. The perceived importance of cultural ecosystem services was influenced by spatial and social factors: Older inhabitants living in periurban areas preferred cultural ecosystem services related to nature experiences. Younger inner city dwellers tended to prefer cultural ecosystem services facilitating social interactions. Those diverging perceptions should to be taken into account through urban development strategies to create a socially just and sustainable city planning in the face of global environmental changes. The ecosystem service framework can be one tool to facilitate a more participatory planning process to find solutions for urban sustainability challenges.

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1. Introduction

More than 50% of the world population lives in cities (World Bank., 2013), in Europe this percentage already amounts to 76% (World Bank., 2016). These percentages are expected to grow, prompting unprecedented challenges for sustainable urban development (Seto, Guneralp, & Hutyra, 2012; Niemelä, 2014). One major aspect of sustainability in cities is the presence of urban green spaces, which contribute positively to urban quality of life through an increase of biodiversity, improve urban microclimate and decrease of pollution and noise (e.g. Bolund & Hunhammer, 1999; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Faehnle, Bäcklund, Tyrväinen, Niemelä, & Yli-Pelkonen, 2014). Other benefits of urban green spaces are the improvement of the overall health, especially through the provision of recreation and relaxation possibilities (Konijnendijk, 2008; Jennings, Larson, & Yun, 2016). By providing possibilities for passive and active recreation in urban green spaces, ecosystem services contribute greatly to urban quality of life (Byrne & Wolch, 2009). However, due to the growing number of inhabitants, urban green spaces are under severe development and use pressure. Shrinking city budgets, low priority on green space development and urban densification can cause balancing difficulties for green space planning. As growing populations demand more space for housing and industrial areas, these demands present substantial challenges to green space planning (Bolund & Hunhammer, 1999; Chan et al., 2007; Seeland, Dübendorfer, & Hansmann, 2009).

To enhance the social and economic productivity of green spaces and the provided ecosystem services, urban green space planning needs to account for the heterogeneity of urban areas. Many studies use a variety of approaches and disciplinary perspectives to analyze urban green spaces (Bertram & Rehdanz, 2015). The concept of ecosystem services developed by the Millennium Ecosystem Assessment (MEA, 2005) can add to the existing literature through a more comprehensive assessment (Daniel et al., 2012), while enabling cross-country and international comparisons (MEA, 2005; TEEB, 2010). Cultural ecosystem services (CES) can be defined as “ecosystems' contributions to the non-material benefits (e.g., capabilities and experiences) that arise from human–ecosystem relationships“ (Chan et al., 2011:206). They refer, inter alia, to aesthetical, educational and religious human–ecosystem relationships (MEA, 2005). CES are still under-researched especially in urban areas, yet will become increasingly important for human well-being in urban environments (Guo, Zhang, & Li, 2010; Radford & James, 2013). Research on CES often uses the overarching term of “cultural services” without distinguishing further or focusses on concepts such as “recreation and tourism”. Limited knowledge exists on how differing social groups value a holistic set of services from urban green spaces (see exceptions by e.g. Chiesura, 2004; Kabisch & Haase, 2014). Social groups perceive nature based on their culturally defined value and belief systems (Faehnle et al., 2014; Friggens, Raish, Finch, & McSweeney, 2014), hence, many previous studies on ecosystem services pointed at difficulties to assess and value CES quantitatively (Daniel et al., 2012; Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013). This is especially challenging in the urban setting, where various green space types, social groups and user demands occur at the same time (Gómez-Baggethun & Barton, 2012). Even though nature-based solutions to environmental problems are usually implemented by policy-makers, research shows that experts' and laypersons' understanding of CES can differ (e.g. Riechers, Noack, & Tscharntke, 2017). To account for those difficulties we show the opinion of the general public using face-to-face questionnaires to account for personal, contextual and spatial influences on urban CES importance (e.g. Oteros-Rozas et al., 2014).

Urban planners and decision-makers are in need of new planning/development strategies to guarantee the sustainability of their green spaces. We therefore aim in our study to answer 1) how CES are perceived in Berlin, 2) whether and how ten different CES suggest contrasting preferences between the services and 3) assess how the socio-demographic status influences the perceived importance of the different CES features. The expected future global changes will affect urban ecosystems and their service provision and pose new challenges for the already tight budgets and contrasting demands cities face regarding urban green space development. Understanding inhabitants' awareness of ecosystem service provisions and their perceived importance holds promise for informing effective planning and design (Jim & Chen, 2006).

2. Methods

2.1. Study side

Our study area was Berlin, capital city of Germany and one of its 17 federal states (*Bundesländer*). With 892 km^2 and 3.5 million inhabitants in 2013, Berlin is Germany's largest and most populated city. The boroughs (*Bezirk*) of Berlin have a population density ranging from 13,818 inhabitants/km^2 (Friedrichshain-Kreuzberg) to 1466 inhabitants/km^2 (Treptow-Köpenick) with even more pronounced differences at the district (*Ortsteil*) level (in 2013, Amt Statistik Berlin-Brandenburg, 2014). Districts also show a great variety of socio-demographic factors such as age and migration background (Kabisch & Haase, 2014). In Berlin, demographic predictions estimate an increase of 250 000 inhabitants until the year 2030 (Senatsverwaltung für Stadtentwicklung und Umwelt, 2015). Social groups such as elderly people and inhabitants with migration background are expected to grow by 29% and 26%, respectively, until 2030 (Senatsverwaltung für Stadtentwicklung und Umwelt., 2012b).

In total, 44% of Berlin is covered by green spaces or bodies of water. The city aims to provide 6 m^2 of urban green space per person (Senatsverwaltung für Stadtentwicklung und Umwelt, 2013). While the aim is mostly reached, green spaces are distributed unequally among the city. Outer districts that have been incorporated into Berlin through urban sprawl contain large amounts of urban green spaces (about 35 m^2 per person) (Kabisch & Haase, 2014). Berlin's development, including the green spaces, has been shaped by its turbulent history. Many green spaces are located along the former line of the Berlin Wall. Another example is the no longer used airport Tempelhofer Feld in the city center that provides a 300 ha open green space with multiple, often bottom-up use patterns. Berlin is a city that recently incorporated various programs and policies that aim for a greener, more sustainable city (see description in Thierfelder & Kabisch, 2016). With its current Urban Landscape Strategy, the Berlin Senate Department of Urban Development and the Environment implemented a general orientation that aims to further develop socially and environmentally conscious urban green spaces (Senatsverwaltung für Stadtentwicklung und Umwelt., 2012a). In Berlin, the green space planning is structured and developed by the Landscape Program/Species Conservation Program that has been implemented in 1994 and the Land Use Plan. Those two approaches are the base for the city-wide green space planning. Through established policies such as the Urban Development Plan, the Biodiversity Strategy and the Urban Landscape Strategy, Berlin aims to support sustainable development and to include differing perspectives on urban green spaces (Senatsverwaltung für Stadtentwicklung und Umwelt, 2015; overview in Thierfelder & Kabisch, 2016).

2.2. Research design and data analysis

This is a study on 10 categories of urban CES based on face-to-face questionnaires done in the city of Berlin. Prior to the questionnaire development, we conducted a qualitative study to uncover perceptions of CES provided by urban green spaces using semi-structured interviews with Berlin inhabitants and experts (n = 41; see Riechers, Barkmann, & Tscharntke, 2016 for details). This resulted in an adjustment of the Millennium Ecosystem Assessment CES categories (MEA, 2005:40) to the urban context and to locally specific perceptions of Berlin

Table 1
Scale and coding of the variables used in the analyses.

Topic	Scale & Coding
Perceived importance of urban CES	7 point rating scale (1, clearly not important to 7 very important) & 4 point rating scale (agree to totally disagree); A total of 23 questionnaire items covering different CES aspects (see Table A.1) were centered with their respective means and aggregated to 10 CES categories: 1) Education; 2) Nature awareness; 3) Aesthetics; 4) Cultural heritage; 5) Sense of place; 6) Religious/Spiritual values; 7) Recreation; 8) Inspiration; 9) Cultural diversity; 10) Social relation
Green space utilization	Average visiting frequency of urban green spaces and perceived accessibility to green space assessed with an ordinal scale
Average distance travelled to urban green	In categories from up to 1 km to more than 10 km. Answers were coded by the category mean
Age, income, education, years of residence	Income was coded by the category mean; education calculated in school years, age and years of residence assessed in years

inhabitants. Specifically, we substituted the MEA category 'traditional knowledge systems' with 'nature awareness' (see Fig. 2). Based on these results we created a questionnaire to quantitatively assess perceived CES importance. To improve structure and wording of the questionnaire, we organized two focus groups and conducted a pilot study ($n = 65$). The questionnaire contained parts on utilization of urban green spaces, perceived importance of CES and socio-demographic information (Table 1, Table A1). In total, 23 different items that cover the differing aspects of CES were assessed.

The sampling frame included all inhabitants of Berlin older than 16 years. Data were collected through face-to-face surveys to ensure the common understanding of all questions by trained interviewers. The questionnaire was administered in four districts of Berlin using proportionate stratified cluster sampling. To include an urban–periurban gradient, city districts were placed in four strata according to population density and selected randomly (Table 2). Because of Berlin's multicentered structure, the population density gradient is not linear from an urban core to an outer periphery. Within the districts, streets and households were sampled randomly. Surveys were conducted on various days of the week between 09:00 and 21:00 o'clock. Households were marked as dropouts after a second unsuccessful attempt to contact them. A response rate of approximately 48% resulted in a sample sized of $n = 558$. To improve representativeness and account for temporal variation in the valuation of CES by season, we collected data in late autumn 2013 and in late spring/early summer 2014 (late autumn: $n = 249$, spring/early summer: $n = 309$).

Data were analyzed using SPSS 21 (IBM Deutschland GmbH, Ehningen, Germany). Missing data were excluded pairwise as missing data and item non-response rates were low. First, we examined relations between 10 categories on perceived CES importance of public urban green using bivariate correlations (Pearson's r coefficient). Statements of importance can be highly influenced by acquiescence bias, i.e. the tendency to agree or positively answer questions. We therefore reduced this bias through subtraction of the individual means of each item (*Ipsatieren*, see Strack, Gennerich, & Hopf, 2008) for the multivariate statistics. We analyzed different social and spatial aspects influencing CES importance using multiple regression analyses of importance of each CES on school years, age and population density. Additionally, we included income, length of residence and average distance travelled to green spaces. We conducted a linear regression of the centered importance of each CES. To control for interference between population density, age and income, we included the urban-periurban correlated variables age and income in a first step and population density in a second step. Further, we conducted a hierarchical (agglomerative) cluster analysis (HCA) using Ward's method and squared Euclidian distance on the importances of CES. HCA clusters were characterized in socio-economic terms. We present results on a two cluster HCE solution, as the resulting clusters showed the most distinct differences in their socio-economic profiles.

Table 2
Study areas and questionnaire size.

Study areas (district)		No. of interviews
Berlin Mitte	Borough: Berlin Mitte Population density: 7850 inhabitants per km^2;	$n = 219$ (39.2%)
Altglienicke	Borough: Treptow-Köpenick Population density: 3422 inhabitants per km^2	$n = 128$ (22.9%)
Mahlsdorf	Borough: Marzahn-Hellersdorf Population density: 2095 inhabitants per km^2	$n = 124$ (22.2%)
Heiligensee	Borough: Reinickendorf Population density: 1665 inhabitants per km^2	$n = 87$ (15.6%)

3. Results

In our sample, gender and age was representative for Berlin (women 51%, men 49%; average age women 44 years, men 42 years, for 2013, Amt für Statistik Berlin-Brandenburg., 2015; Fig. 1). The sample included a slightly higher share of highly educated people in comparison to the average in those districts, possibly due to a biased dropout rate.

In general, the CES category aesthetic values was perceived as most important, with a mean importance rating of 5.8 (1–7) followed by values of nature awareness (5.3), and religious and spiritual values (4.7). Cultural diversity values were, on average, rated as least important (4.0) (Fig. 2). Bivariate correlations between stated importances of CES across participants (strength measured with Pearson's r coefficients) revealed 2–3 sets of CES categories: The first set includes *Social relation* and *Cultural diversity* featuring a Pearson's r with 0.6, and clearly set apart from all other categories. *Education* and *Nature Awareness* form the core of the second set, to which *Religious and spiritual values*, *Aesthetics* and *Recreation* can be added. A weakly bound set comprises *Cultural heritage* and *Sense of place*. Single CES tend to be positively correlated amongst each other but tend to be negatively correlated with the categories of the other sets (Fig. 3). Precise coefficient and significance values of all variables are shown in Table A2.

The three most important socio-demographic variables that explain stated importance of CES categories were education, age, and population density of the sampled area. For some CES categories, the regression improved by adding variables such as income, years of residence in Berlin, and average distance which interviewees travelled to green spaces (Table 3). Age and education had the strongest overall positive influence on perceived CES importance. Income was negatively correlated with CES importance of values for nature awareness, cultural heritage, sense of place and cultural diversity.

HCA analysis resulted in two major clusters of respondents. The two clusters showed pronounced differences in their importance ratings. Members of cluster one included, on average, younger respondents in more densely populated areas who value CES more homogeneously, and who emphasize CES related to human interactions (i.e., cultural diversity and social relation). On average, members of cluster one have not been living as long in Berlin as members of cluster two. Members of cluster one tended to visit public green spaces less often, perceiving them as less accessible. Cluster two contained older respondents, living predominantly in less densely populated areas. Education and income did not differ between the clusters (Tables 4 & 5).

4. Discussion

Our results showed that aesthetics are perceived as most important

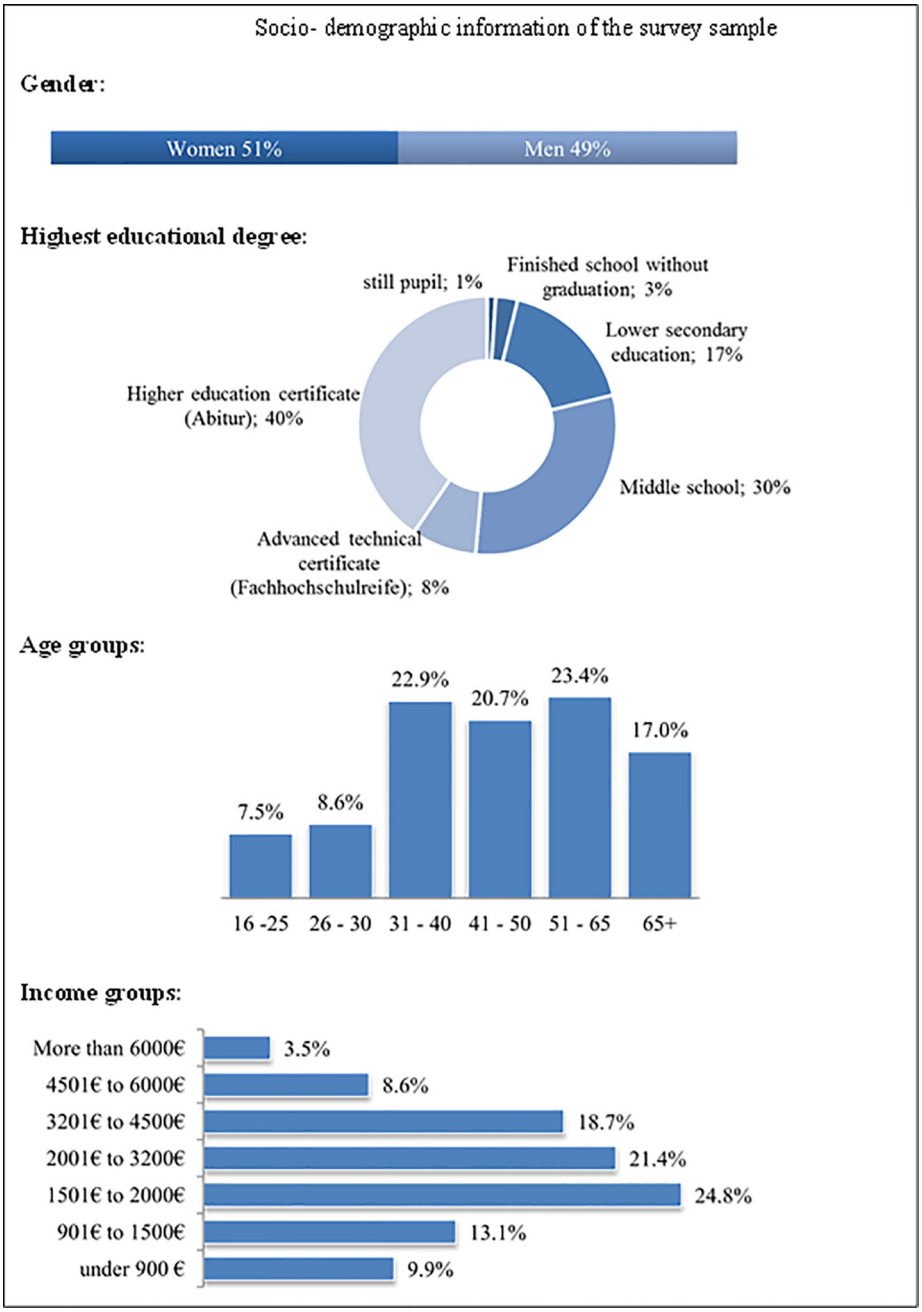

Fig. 1. Socio-demographic information of the sample population in %: Gender, highest educational degree, age group and available monthly income per household.

CES (see similar results in Jim & Chen, 2006). In contrast to other findings (Bertram & Rehdanz, 2015) our result showed a high stated importance of CES related to social activities. In general, all CES are perceived as rather important. Further, our results showed that relations between CES play a significant role for a more comprehensive assessment, as the negative influence between for example social relation and education or religious and spiritual values show. While some studies show many positive links between CES (Plieninger et al., 2013; Bertram & Rehdanz, 2015; Rall, Bieling, Zytynska, & Haase, 2017) our results highlighted more negative correlations between perceived importances of CES. These contrasting results show the heterogeneous character of CES valuation (as described by e.g. Daniel et al., 2012; Plieninger et al., 2013) and necessity for attention to detail: Only looking at an overarching category of cultural service, or to single out only certain services (such as aesthetics, recreation or tourism) without a precise pre-study justifying this focus could potentially give a biased result as respondents might have a more complex understanding of the services generated.

Furthermore, our study showed a dichotomy in valuations of CES between two groups of respondents: (1) a younger group, living in more densely populated areas and preferring CES that positively influence social interactions, (2) an older group, living in more periurban areas of lower population density and ascribed higher importance to direct nature experiences. While there is a higher percentage of older inhabitants living in the periurban areas of Berlin than in some urban core districts (Kabisch & Haase, 2014) our analysis accounted for those confounding factors and nevertheless showed a clear effect of age being a driver for differing perceptions of CES. Our findings support other studies on similar aspects in Berlin (Senatsverwaltung für Stadtentwicklung Berlin, 2004; Rall et al., 2017) and Amsterdam (Chiesura, 2004). However, while our study showed that older inhabitants prefer nature-related, passive recreation in urban green

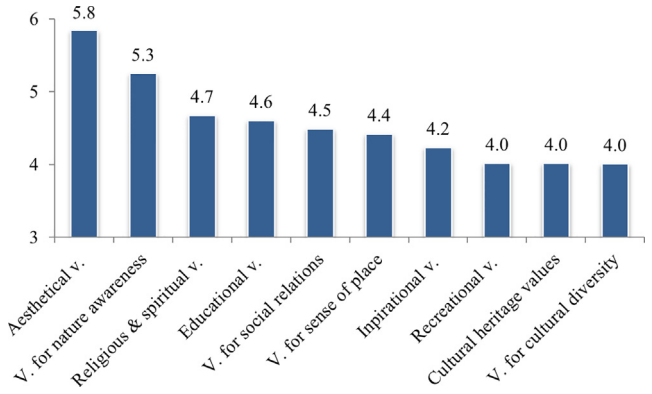

Fig. 2. Mean importance of cultural ecosystem services in the study region; adjusted MEA categories; Scaling from 1 (lowest) to 7 (highest importance). Abbreviation: V = Value.

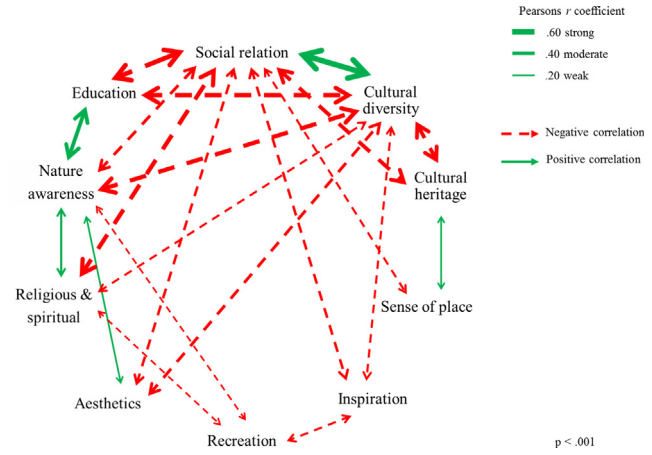

Fig. 3. Bivariate correlations between stated importance of cultural ecosystem services across participants, $p > 0.001$ (2-sided); Strength of the arrows indicate the strength of Pearson's r coefficients. For reference of full CES names see Fig. 1.

spaces, a prior study in Berlin looking at preferences for urban green in relation to planning for Tempelhofer Feld (Kabisch & Haase, 2014) highlights a preference towards social activities. Such contrasting findings further point to the diversity of local study sites within Berlin and the heterogeneity of social groups regarding CES. The prospected future demographic development in Berlin shows a growth of elderly people by 29% until 2030 (Senatsverwaltung für Stadtentwicklung und Umwelt, 2012b). This significant increase will have a great impact on the specific demands on urban green spaces, such as accessibility, shaded areas, resting possibilities etc. As guidelines for an age-friendly environment are acknowledged on the global level (World Health Organization., 2007), further research on preferences as found in this and other studies become of ever more importance for urban development.

Differing and potentially exclusive demands due to socio-economic or cultural heterogeneity (preference of quiet or passive recreation vs social or active activities) may result in utilization contrasts given the scarcity of public urban green spaces in many metropolitan areas

Table 4
Correlation of socio-demographic variables with two clusters for profiling; Eta coefficient, F-Value and significance. Graphical illustration of the two contrasting user groups of urban green spaces in Berlin.

Cluster 1 n = 419 (75.6%)	Cluster 2 n = 135 (24.4%)	Eta	F-Value	p-value
Younger (42.6 yrs.)	Older (54.9 yrs.)	0.344	73.098	< 0.001
Shorter time of living in Berlin	Longer time of living in Berlin	0.312	32.961	< 0.001
Lower visiting frequency to urban green	Higher visiting frequency to urban green	0.150	12.767	< 0.001
Higher population density	Lower population density	0.135	10.261	= 0.001
Urban green perceived as not so well accessible	Urban green perceived as well accessible	0.112	7.028	= 0.008

Table 5
Cluster differences regarding cultural ecosystem service valuation; Eta coefficient, F-Value and significance.

CES	Cluster 1 $n = 419$ (75.6%)	Difference	Cluster 2 $n = 135$ (24.4%)	Eta	F-Value	p-value
Religious/spiritual	4.2	+1.4	5.6	0.421	119.465	< 0.001
Cultural heritage	3.6	+1.3	4.9	0.360	82.933	< 0.001
Education	4.2	+1.2	5.4	0.423	121.209	< 0.001
Nature awareness	4.9	+1.1	6.0	0.355	79.790	< 0.000
Sense of place	4.1	+0.9	5.0	0.273	44.611	< 0.001
Inspiration	4.0	+0.8	4.8	0.260	39.970	< 0.001
Recreation	4.2	−0.5	3.7	0.210	25.744	< 0.001
Aesthetics	5.6	−0.9	6.3	0.275	45.419	< 0.001
Cultural diversity	4.4	−1.3	3.1	0.372	89.163	< 0.001
Social relations	5.1	−1.9	3.2	0.502	187.092	< 0.001

Table 3
Spatial and social-demographic characteristics of valuation: Multiple regression of stated importance of cultural ecosystem service categories on socio-demographic variables, showing standardized Beta coefficients with significance levels (parsimonious models).

Stated importance of CES category	Population density	School years	Age	Income	Years of residence	Distance to green
Education	−0.167***	0.097*	0.280***			
Nature Awareness	−0.111*	0.227***	0.258***	−0.102*		0.136**
Aesthetics	−0.081+	0.169***	0.227***			−0.112**
Cultural heritage	−0.079+	0.137**	0.398***	−0.160**		
Sense of place		.	0.184***	−0.224***		
Religious/Spiritual		0.124**	0.341***			
Recreation		0.162**	−0.386***		0.324***	
Inspiration		0.169***	0.316***			0.123**
Cultural diversity	0.218***		−0.097*	−0.113*		
Social relation	0.267***	0.146**	−0.353***		−0.262**	

+ $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

(Priego, Breuste, & Rojas, 2008; Kabisch & Haase, 2014; Rall et al., 2017). Urban green provides outdoor places to meet, especially in densely populated areas. Yet, the use of urban green spaces for social interactions, such as barbeque, festivities or for sports may hinder and negatively influence CES provision regarding contemplation and recreation (Bertram & Rehdanz, 2015). These differing demands may lead to specific user-conflict due to restricted amount of green spaces areas (Priego et al., 2008; Burger, 2011; Kabisch & Haase, 2014). This stresses the need to find compromises to balance different interests. A better understanding of urban CES is important for social sustainability and needs to be communicated to decision-makers and the public (e.g. Vierikko & Niemelä, 2016). Urban green spaces provide ecosystem service benefits on many levels and scales contributing to the quality of life of inhabitants and the social justice of the city (e.g. Jennings et al., 2016). While the topic of social environmental justice is rather new in Germany, the issue is taken up in recent projects to better inform decision-makers and urban planners (e.g. Flasbarth, 2011).

One example of the power of social groups and their heterogeneous demands on public urban green space is the Tempelhofer Feld in Berlin (e.g. Demokratische Initiative 100% Tempelhofer Feld e. V., 2014). The Tempelhofer Feld is an old airport that is visited in summer by more than 10,000 people (Maier et al., 2012). Although the city of Berlin incorporated participatory planning methods (e.g. organizing public events etc.), the socio-cultural meanings and values of the vast open green in the middle of the city were underestimated. This led to the halt of extensive restructuring plans by local initiatives (see description in Riechers et al., 2017). The Senate of Berlin now initiated a broader and promising dialogue with the inhabitants surrounding the Tempelhofer Feld (Thierfelder & Kabisch, 2016). The ecosystem service framework as an eclectic and heuristic tool to assess broad scale demands and perceived benefits from urban green spaces could be one way to increase information and include inhabitants' opinions.

Global environmental changes such as climate change and demographical changes will have great impact on the urban development of cities. Cities are facing strong pressure for densification or land area expansion which will challenge the provision and planning of urban green spaces (Jim & Chen, 2006; Haase, Kabisch, & Haase, 2013). In Berlin, the main development strategy aims for a densification of the city, posing ever more pressure on non-developed spaces. Some districts in Berlin have significantly lower urban green spaces but a higher proportion of immigrants or a very low percentage of elderly people (Kabisch & Haase, 2014). A city notorious for its tight budget, Berlin decided on a city-wide restructuring and branding of its green spaces through various programs and policies. Berlin recently implemented its Urban Landscape Strategy which has already shown some success (see description in Thierfelder & Kabisch, 2016). Open dialogues and discussion between decision-makers and those affected are often time consuming, yet great value can be found in creating a space to share and maybe shape opinions. The spatial distributions of social groups and their perception of CES can be one way in which urban development and landscape planning can be informed (see also Gómez-Baggethun & Barton, 2012). Larger scale studies on the importance and preferences of urban green spaces' contributions to the non-material benefits as perceived by its inhabitants, can be a helpful tool to shed light on the heterogeneous and sometimes contrasting demands social groups can have. The cluster of urban CES, as described in this study, could optimize data collection through a focus on CES bundles without losing the heterogeneous character of the services. For optimal data collection we suggest the use of reduced item lists of CES, which are supported by highly correlated CES categories. As similar studies have shown a division between more nature awareness related CES bundles and those covering social activities (similar suggestions in Chiesura, 2004; Rall et al., 2017; Plieninger et al., 2013), such a division could be fruitful to simplify valuation tools. Decision-makers of green space planning are often interested in quantified comparisons of differing planning options (e.g. De Groot, Alkemade, Braat, Hein, & Willemen, 2010; Klain & Chan, 2012; Tengberg et al., 2012). Using questionnaires on a broader spatial scale to capture people's perception across districts can be one way of creating a representative overview on individual's preferences and demands.

While there are multiple ways and approaches through which benefits from urban green spaces are measured, we see the ecosystem service framework as a valuable tool to comprehensively survey quantitatively ecosystem service benefits and their distribution among the population. This is also shown by the incorporation of the ecosystem service framework into various European Union policies (overview in Grêt-Regamey, Sirén, Brunner, & Weibel, 2017). Our study adds to the existing literature on the benefits of urban green spaces by highlighting which CES inhabitants perceive as important and how such importance differs among social groups.

5. Conclusion

Cities are a diverse and heterogeneous melting pot of social groups. Perceived green space availability, ecosystem service provision and perceptions of their benefits are likely to mirror such heterogeneity. In our study, we analyzed diverging perceptions of cultural ecosystem service (CES) in Berlin. Our study uncovered underlying social factors and the heterogeneous character of preferences of CES, which are important for a comprehensive understanding necessary to reliably inform political planning processes. Our findings suggest a dichotomy regarding socio-demographic factors by two social groups: Older inhabitants living in the periurban areas of Berlin prefer quiet nature-based recreation, whereas younger inhabitants in the urban core focus on social aspects of CES. These divergent perceptions suggest that local urban green space planning should consider the often non-compatible needs of the users by separating urban green spaces dedicated for either quiet nature-based recreation or the potentially noisy social interactions. District differences in social status, gender, age, distance to urban green spaces and the local provision of ecosystem services, among others, should be acknowledged in socially and spatially specific development plans to allow for a social just and sustainable city. Using a large scale questionnaire survey can be one tool which decision-makers can apply to gather information on the importance of a variety of CES. This information can be an important step to facilitate a more participatory dialogue between policy makers, planners and affected inhabitants in the urban green space planning processes, especially in the face of future challenges posed by climate change, biodiversity loss, demographical changes and social inequalities.

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Appendix

See Tables A1 and A2

Table A1
23 questionnaire items covering different CES aspects. Translated from German.

CES related areas	I visit public green and water spaces in Berlin. 4 point scale of totally agree to totally disagree
Aesthetic	Because you consider the nature in Berlin beautiful
Nature awareness	To experience and discover nature and my environment consciously
Education	To watch and specify animals or to learn about nature
Inspiration	Because nature inspires you
Cultural diversity	Because nature enables the get together of different people (different age and origin)
Social relations	Because you like to meet people in nature or visit festivities
Sense of place	Because you connect many memories with Berlin's nature
Cultural heritage	Because you cherish the history of the Berlin cultural landscape
Spiritual values	Because you have an emotional connection to nature
Recreation	Because there you can disconnect from the city life and recreate
Recreation	To be active and do sports there
	How important is it for you (considering green and water spaces in Berlin). 7 point scale of importance (1–7)
Aesthetics	That you consider those places beautiful
Spiritual values	That you have the feeling, that there is something mightier than you
Recreation	That it is quiet and you can be alone
Nature awareness	That it is enabled, to introduce children to nature
Education	That school and kinder gardens can communicate about nature outside
Inspiration	That nature inspires art and culture
Cultural diversity	That all people (independent from age and heritage) have the possibility to use the places according to their ideas.
Social relations	That you can undertake something with other people outside
Social relation	That you get to know different people and learn from them
Sense of place	That nature helps to feel at home here in Berlin
Cultural heritage	That the historical meaning of Berlin's landscape is shown
Recreation	That you can do different sports there

Table A2
Bivariate correlations between CES variables across participants. Strength shown through Pearson's *r* coefficient.

	Aesthetics	Religious/spiritual	Recreation	Nature awareness	Education	Inspiration	Cultural diversity	Social relations	Sense of place
Religious/spiritual	0.186***	1							
Recreation	0.055	−0.214***	1						
Nature awareness	0.215***	0.240***	−0.200***	1					
Education	0.065	0.185***	0.003	0.408***	1				
Inspiration	−0.181***	0.150***	−0.217***	0.070	0.145**	1			
Cultural diversity	−0.359***	−0.422***	−0.066	−0.457***	−0.480***	−0.257***	1		
Social relations	−0.284***	−0.467***	0.137**	−0.347***	−0.520***	−0.264***	0.634***	1	
Sense of place	0.048	0.073	−0.045	−0.116**	−0.024	−0.199***	−0.124**	−0.240***	1
Cultural heritage	−0.048	0.155***	−0.072	0.046	0.198***	0.158***	−0.441***	−0.437***	.200***

** $p < 0.01$ (2-sided).
*** $p < 0.001$ (2-sided).

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